



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Art Unit: 4162

Masashi TAKAHASHI

Examiner: QIAN, YUN

Serial No.: 10/583,906

Filed: June 22, 2006

For: Liquid Stock for Dropping, Method for Preparing Liquid Stock
for Dropping, Method for Preparing Uranyl Nitrate Solution,
and Method for Preparing Polyvinyl Alcohol Solution

DECLARATION

Honorable Commissioner of Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

I, Masashi TAKAHASHI, declare that:

1. I am the inventor of the present application and am familiar with the subject matter disclosed in the application, the rejection of claims 3-11 and 18-22 under 35 U.S.C. §103(a) as unpatentable over Hideji et al. (JP 05-279043 A), claims 12-14 under 35 U.S.C. §103(a) as unpatentable over Hideji et al. as applied above, further in view of Larson et al. (US 5,514,306) and Krishnamurthy et al. (US 4,778,665), and claims 15-17 under 35 U.S.C. §103(a) as unpatentable over Hiroji et al. (JP 06-066756 A) as well as the disclosures in the cited references.

2. I graduated from Hokkaido University with a Bachelor's degree in atomic engineering in March of 1993. I entered NUCLEAR FUEL INDUSTRIES, LTD. in April of 1993 and was engaged in development of and research on materials for light water reactors. I was transferred to the Advanced Reactor Fuels Department in July of 2000. Since then I have been engaged in development of and research on fuel for high-temperature gas-cooled reactors. In the meantime, I was temporarily transferred to the Japan Atomic Energy Agency, a governmental institute, and worked there between September of 2000 and March of 2002.

3. I carried out an experiment to demonstrate patentability of amended claim 3 of the present application over the Hideji et al. document.

Specifically, I prepared fuel kernels produced from six feedstock liquid samples with different amounts of tetrahydrofurfuryl alcohol, which will be abbreviated to THFA hereinafter. Fuel kernels were prepared by the same method as in Working Example 2 of the present application. Specific steps of preparing each feedstock liquid sample are described in the following.

A liquid mixture was obtained by adding 300 g of powdery polyvinyl alcohol, or PVA powder, to 4 L of pure water. The mixture was stirred for 90 minutes at 95°C, which resulted in an aqueous PVA solution, the PVA content of which was 7% by mass. No undissolved PVA residue was observed in the aqueous solution thus prepared. Then, THFA was added to the aqueous PVA solution at 80°C so that the concentration of the THFA added at this stage would be 16.5 vol.% of the volume of the feedstock liquid to be prepared. A PVA solution was thus

obtained.

A uranyl nitrate mixture was prepared by mixing about 9 L of the uranyl nitrate solution with THFA in such an amount that the prepared feedstock liquid would include THFA in a predetermined concentration. The PVA solution obtained above, the uranyl nitrate mixture, and pure water were mixed, which produced the feedstock liquid.

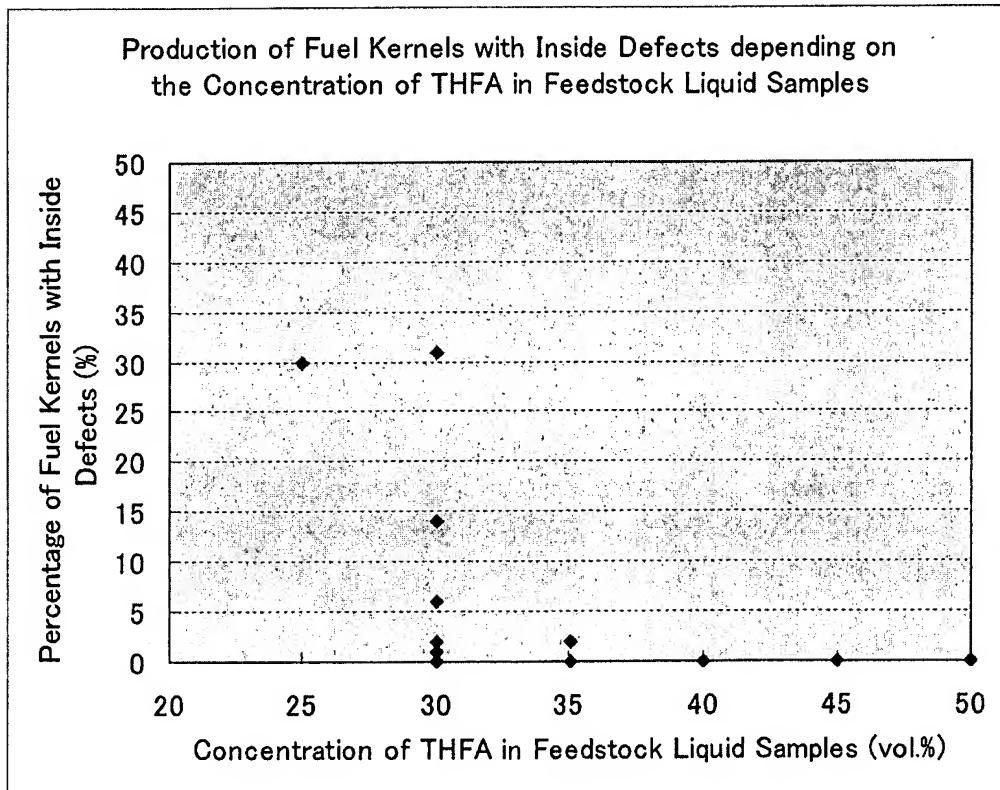
I prepared six feedstock liquid samples each with 25 vol.%, 30 vol.%, 35 vol.%, 40 vol.%, 45 vol.% and 50 vol.% of THFA. I produced ammonium diuranate particles by dripping at least one batch of each feedstock liquid sample to an aqueous ammonia solution. Specifically, one batch of the feedstock liquid sample with 25 vol.% of THFA, nine batches of the sample with 30 vol.% of THFA, two batches of the sample with 35 vol.% of THFA, three batches of the sample with 40 vol.% of THFA, thirteen batches of the sample with 45 vol.% of THFA, and one batch of the sample with 50 vol.% of THFA were dripped and ammonium diuranate (ADU) particles were produced. After being dried, the dried ADU particles were calcined in the atmosphere at 550°C for one hour. The resultant uranium trioxide particles were reduced and sintered in a mixture of hydrogen gas and nitrogen gas at 1550°C for one hour, which produced fuel kernels. One hundred fuel kernels were randomly taken in each batch and the taken kernel were ground from a pole near to the equator, so that sections taken along a line near the equator line were exposed. Then, the exposed sections were observed with a light microscope, so that whether or not defects such as cracks existed was determined. The number of the fuel kernels that had inside defects was counted for each batch. The results are shown in the table below.

Table

Number of Fuel Kernels with Inside Defects

THFA (vol. %)	Batch No.												
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13
25	30	-	-	-	-	-	-	-	-	-	-	-	-
30	31	0	14	0	0	2	6	1	0	-	-	-	-
35	0	2	-	-	-	-	-	-	-	-	-	-	-
40	0	0	0	-	-	-	-	-	-	-	-	-	-
45	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	-	-	-	-	-	-	-	-	-	-	-	-

The results are also shown in the following figure.



The figure shows that fuel kernels had inside defects when the concentration of THFA in the corresponding feedstock liquid samples was 35 vol.% or less, although the results somewhat varied.

Although the specification is silent about the relationship between the concentration of THFA and defects inside a fuel kernel, the skilled artisan would be able to understand the followings without difficulty.

As explained under the heading of "BACKGROUND ART" of the specification, fuel for the high-temperature gas reactor typically comprises a fuel kernel and a coating layer with which the fuel kernel is covered. When fuel kernels have defects inside them, fission gas, which is produced when nuclear fission in a nuclear reactor is advanced, reaches the coating layer of the fuel kernels quickly through the defects such as cracks. Although in actual embodiments, the coating layer of a fuel kernel has concentrically laminated sub-coating layers that function as a barrier against leakage of the fission gas from fuel particles, the defects at least reduce the time period necessary for the fission gas to reach the coating layer. Supposing that the coating layer has a same ability of confining fission gas in it whether the fuel kernel has defect inside it or not, fuel particles having fuel kernels with more defects inside them are prone to leak fission gas through the coating layer. Once fission gas leaks through the coating layer out to the nuclear reactor, it quickly expands in the reactor. Therefore if many fuel kernels with inside defects are fed to the nuclear reactor, the safety system thereof may be activated and the reactor may be shut down. Needless to say, the shutdown of a nuclear reactor means that the high-temperature gas-cooled reactor can no longer serve its purpose, such as power generation or hydrogen production.

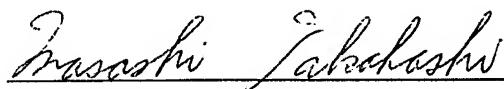
Hideji et al. are completely silent about the amount of THFA.

Use of fuel kernels with inside defects may result in leakage of fission gas from the kernels through the coating layer, which, in turn, may lead to a shutdown of the nuclear reactor.

The amount, 40-50 vol.%, of THFA in the feedstock liquid, defined in amended claim 3 is critical to ensure safe operation of high-temperature gas-cooled reactors.

The undersigned declarant declares further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 22nd day of December, 2008.



Masashi TAKAHASHI

Partial Translation of JP 6-66756 A
Your Ref. 06364/HG, Our Ref. G102US



-PARTIAL TRANSLATION-

Unexamined Patent Application Publication No. 6-66756 (1994)

Publication Date: March 11, 1994

Application No. 4-223100

Application Date: August 24, 1992

Inventors: Hiroji MURAKAMI, Ken-ichi NAKA, Shinji HARAFUJI, and Iwao ABE

Applicant: Tokyo Cosmos Electric Co., Ltd.

Title of the Invention: Paste for Moisture Sensitive Resistor of Dew Sensor and its Manufacture

[0006]

The paste for a moisture sensitive resistor of a dew sensor includes 20-30 parts by weight of water, 9-11 parts by weight of polyvinyl alcohol, 2-3.5 parts by weight of acetylene black, 1.0-2.8 parts by weight of powdery graphite, 2.0-3.0 parts by weight of boron nitride, 15-20 parts by weight of tetrahydrofurfuryl alcohol, and 1.0-2.0 parts by weight of n-octyl alcohol.

[0011]

The amount of ion-exchanged water and that of polyvinyl alcohol are not limited to those mentioned above. Ion-exchanged water in an amount from 50 to 150 parts by weight and polyvinyl alcohol in an amount from 9 to 11 parts by weight may be introduced in the container.

[0014]

(iii) Concentrating Step

The mixed liquid obtained in the mixing and grinding step is moved to a kneader equipped with a heater, and the mixed liquid is kneaded while the liquid is being heated and kept at 105-110°C. Dried air is introduced into the kneader, and the atmospheric gas in the kneader is sucked through a condenser tube. Water vapor in the atmospheric gas is condensed, separated and collected in another container. Then, the heating is stopped, and a concentrated mixed liquid is cooled while being stirred. 58 parts by weight of the ion-exchanged water that was added during the dissolving step has been

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vaporized and 24 parts by weight thereof remains in the mixed liquid. When the amount of the added ion-exchanged water is from 50 to 150 parts by weight, fractional distillation is carried out so that 20-30 parts by weight of the ion-exchanged water remains in the mixed liquid.

[0015]

(iv) Alcohol-adding Step

To the concentrated mixed liquid having been prepared in the kneader in the concentrating step is added 2.0 parts by weight of tetrahydrofurfuryl alcohol. The resultant is stirred. Then, 1.6 parts by weight of n-octyl alcohol is added to the resultant and the mixture is stirred. Thus, a compatible mixed liquid with a lowered viscosity is obtained.

[0016]

The amount of tetrahydrofurfuryl alcohol may be from 15 to 25 parts by weight, and that of n-octyl alcohol may be from 1.0 to 2.0 parts by weight.